



NAVAL SURFACE WARFARE
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Strategic Sealift JLOTS R&D Overview

04-06 FEB 2003

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Strategic Sealift JLOTS R&D Overview



CSS R&D Topics:

- Ship-to-Ship Vacuum Mooring
- Secure Anchoring
- Vessel Motion Analysis
- Integrated Rider Block Tagline System (IRBTS)
- Ship Roll Mitigation System (SRMS)

Ship-to-Ship Vacuum Mooring



(From: TACS/Containership Interface)

By Mooring International,
Ltd.

Lyttelton, New Zealand

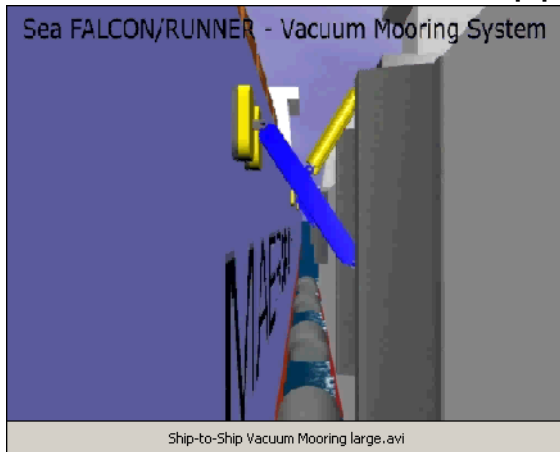
MIL Vacuum Mooring orig.avi



Quay Sailor in Action MPG-2.mpg

Original Vacuum Mooring System:

- Tutorial on first commercial application



Ship-to-Ship Vacuum Mooring large.avi

Ship-to-Ship Vacuum Mooring Concept:

- Ship mounted vacuum system to attach to available freeboard of approaching

New Hardware by Mooring Systems, Ltd.:

- Company expanded design to pier based mooring (name changed from MIL to MSL).
- Expands use of vacuum mooring for pierside attachment of all ships with adequate freeboard.
- System provides play for changes in heel angle and ship draft.
- Ship-to-Ship mooring would require more

Secure Anchoring

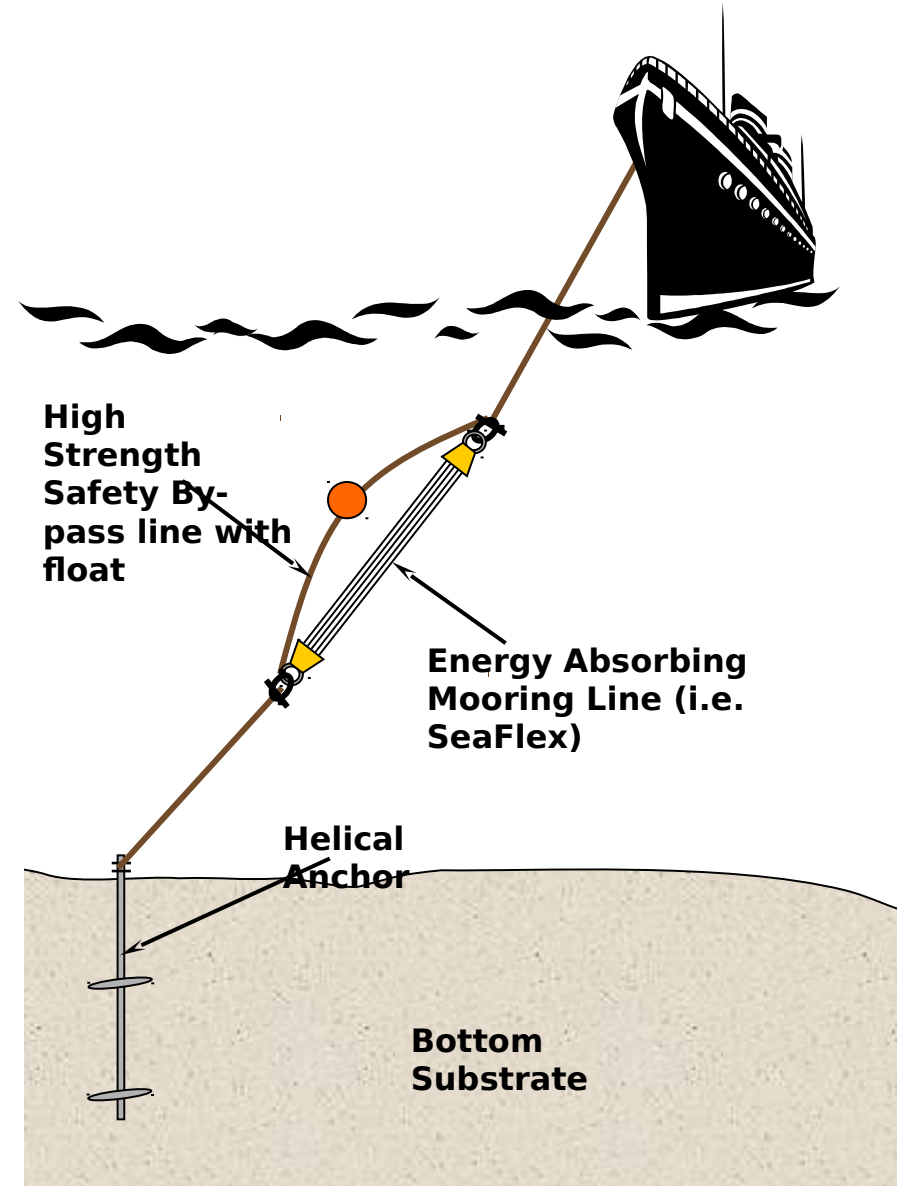
(From: Ship Attached RIB Section)



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Problem:

- Current anchoring technology is limited
 - Embedment anchors are large & heavy
 - Prone to drag (i.e. CAPE MOHICAN)
 - Need constant tending w/multipoint mooring
 - Limited in maximum useful depth
- Helical anchors provide a light & secure alternative
 - Proven for mooring up to SS-5
 - Hold is secure without dragging
 - Extremely high hold to weight ratio
 - Small scope needed vs. embedment anchors
 - Currently can deploy in up to 100 ft. water depth
 - Would need to develop a larger version of SeaFlex energy absorption line for ship mooring



Recommended Development:

Secure Anchoring



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Current Capability:

- Workboat mounted drill rig
 - Can be mounted to most small vessels
 - Operable up to 100 foot water depth
 - Sea state is limited to the workboat capability
- High strength mooring line
 - SeaFlex provides absorbtion of vessel motion
 - Single line limited to a nominal 1.000 lbs.



Concept:

- Remotely operated, submersible drill rig
 - Could be be used in “unlimited” depth
 - Benefit to MOB, Seabasing, Oil industry
 - Can be operated from ship, eliminating need to deploy small craft in heavy sea state
 - Needs larger dampening mooring line similar to SeaFlex



Vessel Motion Analysis

(From: Ship Attached RIB Section)



CSC Vessel Motion Analysis:

- CSC, Advanced Marine, improved upon an original vessel motion analysis of a T-ACS, Containership & LCU-2000 for various orientations of wind driven waves and swell. The fidelity and flexibility of the new motion analysis tool is much greater than the original.
- The maximum relative and absolute motions, velocities, and accelerations of the vessels were still computed with 95% confidence.
- The significant waveheight and swell height were originally combined and constrained to form sea-state 3 (SS-3). The new spreadsheet allows for completely variable seas by allowing the user to specify both overall height and modal period for swell and wind-driven seas.
- Initial baseline calculations were carried out in each spectrum individually, at 9 wind driven and 9 swell wave headings. The updated version has 24 headings for each.
- Calculations were performed for all 576 combinations of sea and swell headings and presented in a 3D Excel file.
- Can be used to predict both relative and absolute motions for each vessel.
- Provides a tool to determine best vessel orientation in any give sea conditions.

Vessel Motion Analysis



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Relative motion of: TACS-LCU2000

Direction: Vertical

Displacement, ft

Acceleration, ft/sec²

Wave Conditions

Significant Wave Height, ft 4.24

Sea State 4

Sea Significant
Height, ft

3



Sea Modal
Period, Sec

7



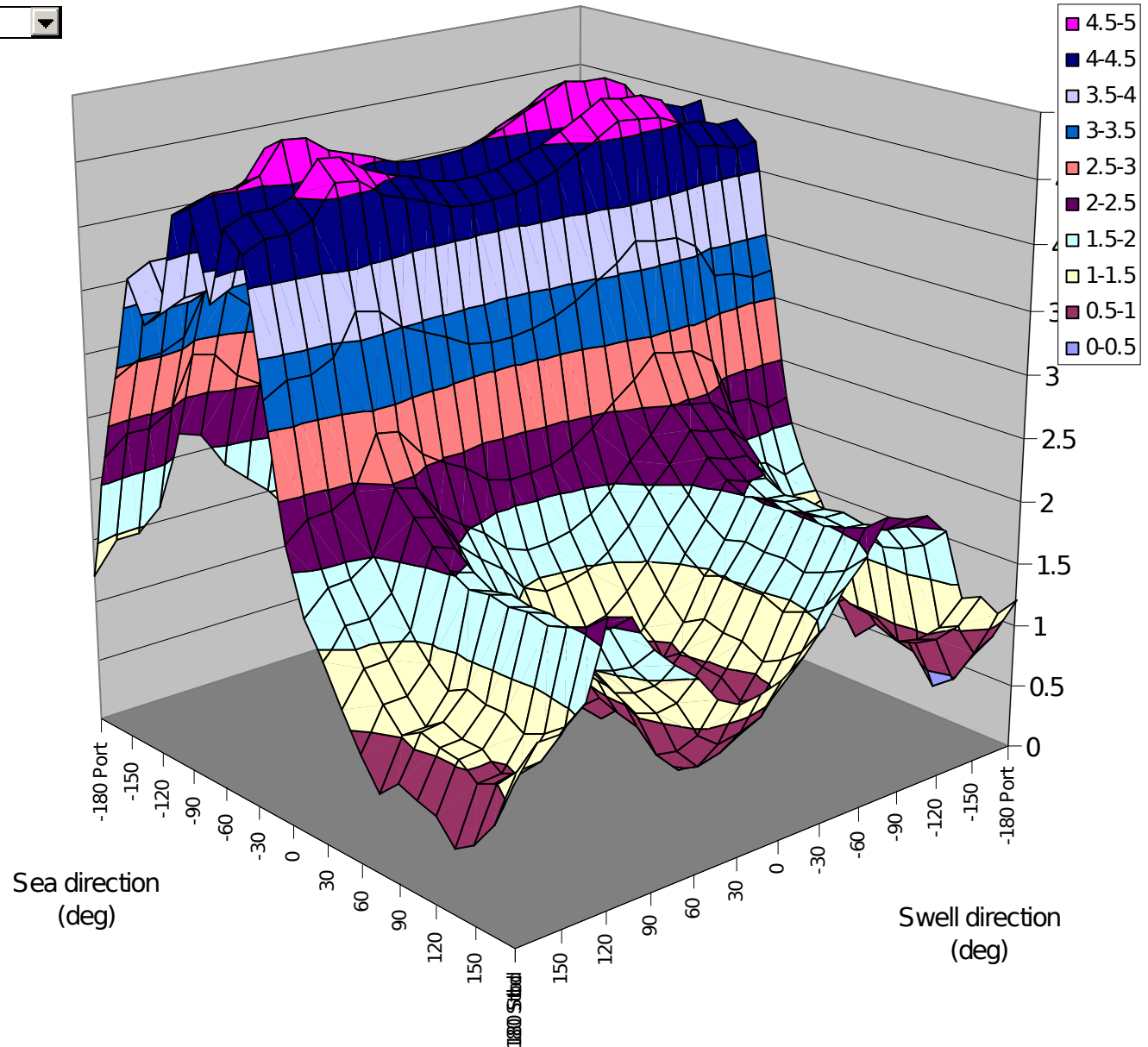
Swell Significant
Height, ft

3



Swell Modal
Period, Sec

16



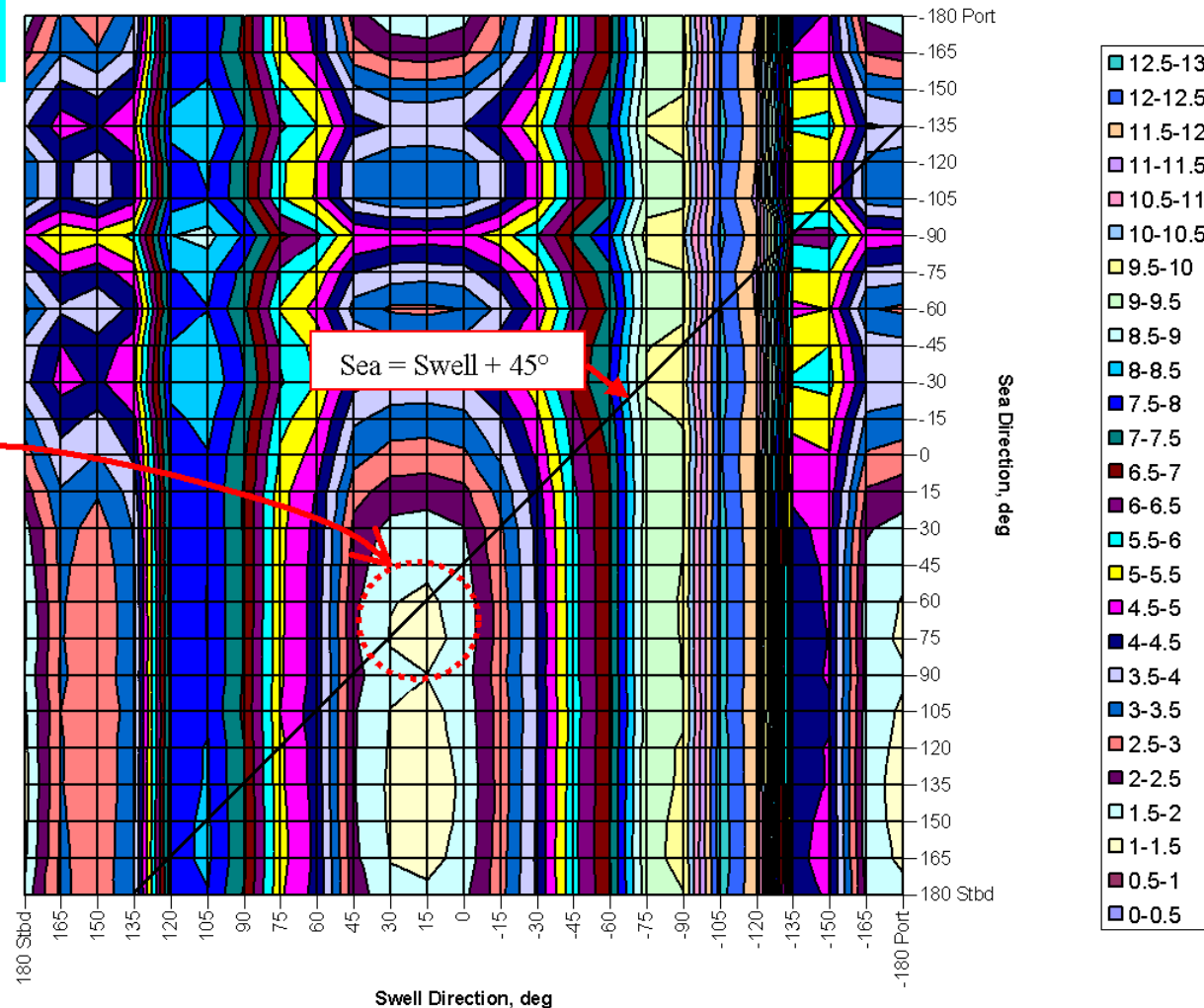
Vessel Motion Analysis



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Vessels: TACS-LCU2000
Direction: Vertical
dV/a: Velocity

Region of
Minimum Relative
Velocity



Contour plots of vessel motions can be used to find the best vessel orientation for any given sea conditions. In this example, the graph is rotated slightly clockwise and positioned for a top-down view. The plotted line represents the wind driven sea being 45 degrees clockwise from the swell heading. The minimum relative vertical velocity for the T-ACS and LCU is with the sea at 65 degrees and the swell at 20 degree off to the Starboard side relative to the T-ACS.

Integrated Rider Block Tagline System (IRBTS)



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T-ACS
1

Summary:

IRBTS Status:

- T-ACS 1, 2 & 3 crane controls have been upgraded
 - IRBTS imbedded into control logic of electric cranes
- Prototype being removed from T-ACS 5 as CC2000 card being installed
 - CC2000 is a new control card from MacGregor, the OEM crane manufacturer
 - CC2000 has IRBTS control algorithm already imbedded in card
 - May be used with or independently from Pendulation Control System (PCS)
- LMSR installation on USNS MENDONCA (T-AKR 303) nearly complete
 - Activation of MENDONCA delayed twin mode test and final demo
 - Will finish testing when MENDONCA returns



USNS MENDONCA

Ship Roll Mitigation System (SMRS)



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OBJECTIVE:

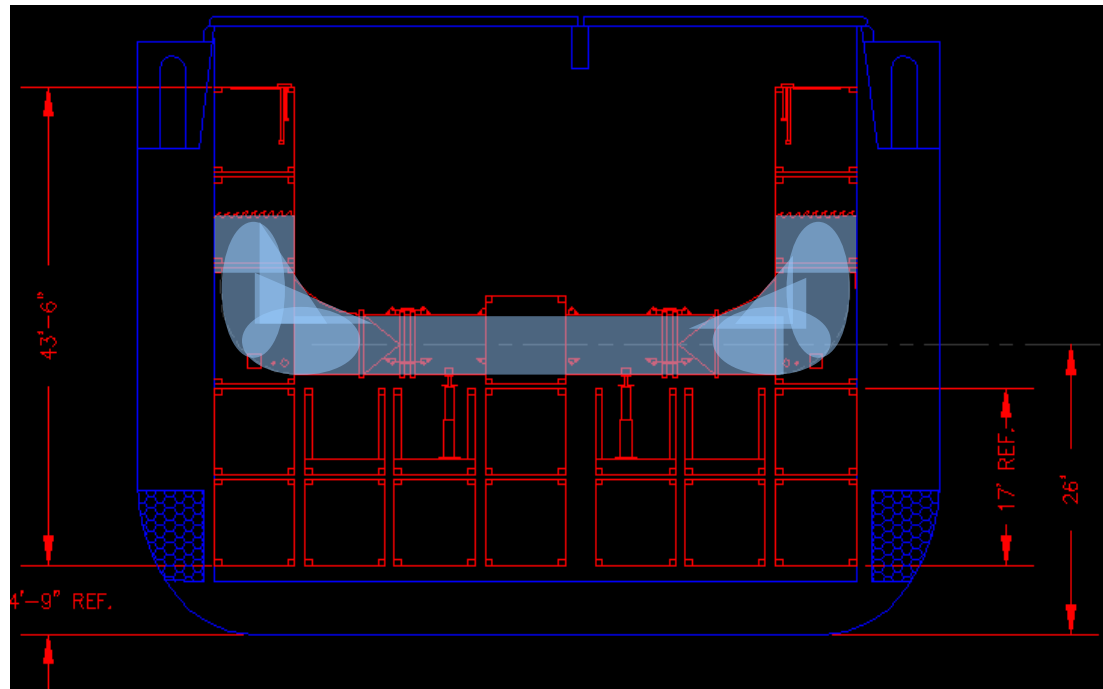
Investigate the Ship Roll Stimulator System (SRSS) concept to determine if controls can be adapted to mitigate ship roll through repeated system operation in opposition to wave caused ship motion

PAYOFF

Reduce ship motion from swells while at anchor during JLOTS cargo operations using the SRSS technology, which will continue to be used to create roll while pierside for testing and training.

STATUS/PLANS: JAN03

- Algorithm study by Craft/Old Dominion University completed and several control models formulated.
- Hardware modifications and test plan to verify control methodology with SRSS 1/8th scale near completion.
- Modifying full scale controls and testing of SRMS can occur after the SRSS



Ship Roll Mitigation System (SMRS)



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SRSS Mid-River Test Clip.avi

MID-RIVER TEST: 25SEP02

- Demonstrates ability of hardware to stimulate and possibly mitigate ship roll.
- Obtained +/- 3.5 degree roll in York River with an 11.8 sec. stimulation period in approx. 35 foot water depth (not ideal).
- Test used to help select new props.
- Ship stability was verified for



SRSS Removal 18DEC2002 MPG-2.mpg

SRSS Removal: 18DEC02

- SRSS removal required for shipyard repair and possible activation.
- Operational requirement to have system removed within 48 hours.
- Total time for all operations was under 24 hours.
- The FLICKERTAIL STATE (T-ACS 5) will be in shipyard for repair in FEB-MAR.
- Not known yet if ship will be called into

Ship Roll Mitigation System (SMRS)



OVERALL OBJECTIVE:

SRMS will:

- **Provide engineering data for designing active flume systems into new vessels**
- **Serves as a proof of concept of a modular flume system for possible retrofit in existing vessels.**
- **Ultimate goal is to improve cargo handling & safety, and increase throughput**
 - **Current process cannot meet 300 container/day offload requirement**
 - **Need system of systems approach (i.e. SRMS, PCS, IRBTS, INLS, Vacuum Mooring, Deep Draft Fender, etc.)**
 - **Must be able to reduce the effect of swell on ships and wind-driven seas on lighters CONCURRENTLY or lose throughput because of failure of one or the other...**